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Floristics and life-forms along a topographic gradient, central-western Ceará, Brazil

Florística e formas de vida ao longo de um gradiente topográfico no centro-oeste do estado do Ceará, Brasil

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Abstract

To test whether the flora is organized in discrete or continuous units along a topographic gradient, three physiognomies were assessed on different soil classes in a semi-arid region of northeastern Brazil: *caatinga* (xeric shrubland) at altitudes from 300 to 500 m, deciduous forest at altitudes from 500 to 700 m and *carrasco* (deciduous shrubland) at 700 m. In each physiognomy a species inventory was carried out, and plants were classified according to life- and growth-forms. Species richness was higher in the deciduous forest (250) than in the *carrasco* (136) and *caatinga* (137). The *caatinga* shared only a few species with the *carrasco* (6 species) and the deciduous forest (18 species). The highest species overlap was between the deciduous forest and the carrasco (62 species). One hundred and four species occurred only in the *caatinga*, 161 only in the deciduous forest and 59 only in the *carrasco*. Woody species predominated in physiognomies on sedimentary soils with latosol and arenosol: 124 species occurred in the deciduous forest and 68 in the *carrasco*. In the *caatinga* on crystalline basement relief with predominance of planosol, herbs showed the highest species richness (69). Comparing the biological spectrum of Brazilian plant life-forms, the *caatinga* stood out with higher proportion of therophytes and chamaephytes. Considering the flora of the three phytophysiognomies studied here, we can affirm that the *caatinga* is a discrete floristic unit.

Key words: vegetation classification, biological spectrum, growth-form, phytoclimate, plant community.

Resumo

Para verificar se a composição florística constitui unidades discretas ou contínuas ao longo de um gradiente topográfico foram analisadas três fitofisionomias (caatinga sobre altitudes de 300 a 500 m, floresta decídua sobre altitudes de 500 a 700 m e carrasco sobre atitudes de 700 m) sobre classes de solos distintas no semi-árido setentrional do Nordeste do Brasil. Em cada fisionomia foi realizado o levantamento das espécies, as quais foram classificadas em formas de vida e de crescimento. A riqueza de espécies foi maior na floresta decídua (250) do que no carrasco (136) e na caatinga (137). A caatinga apresentou poucas espécies em comum com as fitofisionomias de carrasco ou de floresta decídua (6 e 18 espécies). A maior sobreposição de espécies ocorreu entre a floresta decídua e o carrasco, 62 espécies. Foram exclusivas da caatinga, floresta decídua e do carrasco, 104, 161 e 59 espécies, respectivamente. Quanto às formas de crescimento, nas fisionomias sobre relevo sedimentar com Latossolo e Arenosolo predominaram espécies lenhosas: 124 na floresta decídua e 68 no carrasco. Na caatinga sobre relevo do embasamento cristalino com predominância de Planossolo, a maior riqueza de espécies (69) foi de ervas. Na análise comparativa do espectro biológico com outras formações brasileiras, o de caatinga se destacou dos demais, constituindo uma unidade individualizada pela maior proporção de terófitos e caméfitos. Em relação à flora das três fisionomias, objeto deste estudo, pode-se afirmar que a da caatinga representa uma unidade discreta.

Palavras-chave: classificação de vegetação; espectro biológico; forma de crescimento; fitoclima, comunidade vegetal.

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Introduction

At a global scale, the main environmental variables used to classify vegetation are climate zones. A group of similar vegetation types that occur in similar climate zones in different continents is known as a vegetation-type or biome (Whittaker 1975, 1978a, b; Box & Fujiwara 2005).

Changes in topography or microclimate can affect the biology of the vegetation, leading to particularities that can be detected only at a local scale (Spellerberg & Sawyer 1999). Gradual changes in climate related to topography or to distance from the ocean, at a small scale, result in continuous vegetation units, which makes a classification based on floristic attributes difficult. However, when a climate variable is associated with different soil types, the regional flora may be discontinuously distributed, forming discrete communities, whose limits, along a topographic gradient, can be determined by an analysis of floristic composition and of the main growth- or life-forms of the plant species (Whittaker 1975; Box & Fujiwara 2005).

To describe community types it is necessary to characterize plant forms, since physiognomy results from the dominant forms that compose a community (Whittaker 1975). Classes or types of plant forms are called growth-forms; this classification usually does not correspond to the categories used by taxonomists to classify plants. Height, woody or herbaceous habit, stem form, leaf form and intensity of leaf deciduousness are characteristics used to define the following types of growth-forms (Whittaker 1975): trees, shrubs, lianas, epiphytes, herbs and thallophytes.

Instead of using a system of multiple characteristics such as the growth-form system proposed by Whittaker (1975), the life-form system of Raunkiaer (1934) is based on a single characteristic: the relationship between the position of the perennial tissue (meristem), which remains inactive during the winter or dry season, and the growth surface. The life-form of a species represents a set of life history characteristics selected by the environment. Raunkiaer (1934) classified plants into five life-forms: phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes.

The world spectrum, or normal spectrum, was calculated by Raunkiaer (1934) based on a representative sample of all the vascular flora of the world. From that sample, the patterns recorded in different directions reflect environmental effects, especially related to climate, on plant adaptations observed in a community (Raunkiaer 1934). Hence, whereas the growth-form classification is used to characterize community structure (because some forms are dominant or more conspicuous), the life-form spectrum describes environmental adaptations of the species that compose that community (Whittaker 1975; Raunkiaer 1934). Indirectly, this system provides information on local seasonality. According to Whittaker (1975), life-forms are not a structural attribute, but a floristic attribute: when the number of species is converted into percentage of life-forms, this percentage would represent the spectrum of life-forms in this community or geographic area. The fact that a given community is characterized by particular life-forms indicates species convergence toward certain environmental conditions; and this represents a functional attribute of the community.

In the present study, we assessed life-forms, growth-forms and floristic composition of three neighboring physiognomies that occur under different climates, soils and topographies. These community attributes were determined for an area located in the semi-arid region of northeastern Brazil, which comprises two geomorphological units: sedimentary basin and crystalline basement.

Based on these data, we tested the following predictions: i) the floras of the two geomorphological units are different, and constitute two discrete units; ii) the life-form spectrum varies according to altitude and soil type, probably as a consequence of differences in water availability, resulting mainly in the occurrence of phanerophytes in the sedimentary basin and of therophytes in the crystalline basement.

Material and Methods

Location and environmental characterization of the study area

Serra das Almas Natural Reserve covers an area of 5,646 ha, and is located between the coordinates 5°15'–5°00'S and 40°15'–41°00'W (Fig. 1). The study area has three physiognomies: i) *caatinga* (xeric shrubland) with an area of 17.10 km² (29.19%), ii) seasonal deciduous forest with an area of 27.93 km² (47.64%) and iii) *carrasco* (deciduous shrubland)(Rougerie 1988) with an area of 11.79 km² (20.12%).

The study area is located in two geomorphological units: i) the crystalline basement complex, with flat to slightly undulating relief and

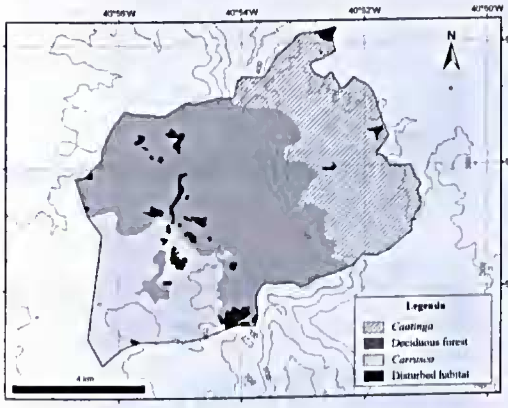

Figure 1 – Location of Serra das Almas Natural Reserve, Crateús, state of Ceará, Brazil.

low altitude (c. 400 m) and ii) the Meio Norte sedimentary basin, on its eastern margin, which forms an asymmetric cuesta, known as Ibiapaba Plateau (altitudes between 500 and 700 m).

The caatinga occurs in the crystalline basement complex, where the dominant classes of soils are: Solodic Planosol, Solodized Solonetz (natric Planosols) and Lithic soils (Lithic Neosols) at altitudes that vary from 300 to 500 m.

In the Meio Norte sedimentary basin, on Ibiapaba Plateau, the Latosol occurs on the eastern hogback and quartz sand (quartzarenic neosols) on the top and backside (Brasil 1972). The deciduous forest occurs on the eastern hogback of the plateau, on Latosol, at altitudes between 500 and 700 m. The carrasco is present on the backside of the plateau, on quartz sand, at altitudes of ca. 700 m. We emphasize that the Ibiapaba Plateau is a 'cuesta', with higher asymmetry in its southern part, our study area, where there is no top, but an inverted V-shaped topography where the leeward on the backside exhibits a smooth declivity.

Climate data were not available, because there are no meteorological or pluviometric stations located on the cuesta, top and immediate backside sites on the southern part of the Ibiapaba Plateau, our study area.

Floristic inventory

The flora of Serra das Almas Natural Reserve was extensively sampled from 1999 to 2004, in several projects: reserve management plan; long-term ecological research programs – Site Caatinga/CNPq/PELD; Instituto do Milênio do Semiárido-IMSEAR; Biodiversity inventories – Caatinga (PROBIO-MMA) and Edital Universal do CNPq / 476285/2003-8. In these studies, branches of angiosperms (five duplicates) in reproductive phase (flower buds, flowers and/or fruits) were collected on trails and inside the best-conserved fragments of each physiognomy. Vouchers were deposited in the Prisco Bezerra Herbarium (EAC), of Universidade Federal do Ceará. Botanical identification was carried out using analytical keys (Freire 1983; Barroso *et al.* 1978, 1984, 1986) and by comparison with the material present in the EAC Herbarium or, when necessary, by consulting specialists. The classification used was APG III (2009). Species names were updated considering the synonymy of Missouri Botanical Garden (Tropicos.org 2009); names and/or abbreviations of species authors were written in accordance with Brummitt & Powell (1992).

Growth- and life-forms

Each species was classified into growth-forms following Whittaker (1975).

The classification of each species in life-forms was done based on the protection level of growing tips and on the reduction of the aerial part during the unfavorable season, following Raunkiaer (1934, see also Cain 1950; Mueller-Dombois & Ellenberg 1974): therophytes (Th), cryptophytes (Cr), hemicryptophytes (H), chamaephytes (Ch) and phanerophytes (Ph). Woody lianas and cacti were considered as phanerophytes and non-woody lianas were classified according to the level of reduction of their aerial part during the dry season (according to Raunkiaer 1934).

Data analysis

Floristic data were organized as a list with families, species, vernacular names, life and growth-forms, physiognomy and collectors. We calculated species and family richness for the whole dataset and by physiognomy. To compare the richest families between physiognomies, we used histograms with the ten richest families in descending order.

Floristic overlap between physiognomies was analyzed by calculating the frequency of species and families in overlapping classes: occurrence in all physiognomies, in pairs of physiognomies (*caatinga/carrasco*, *caatinga*/deciduous forest, *carrasco*/deciduous forest), and restricted to each physiognomy (*caatinga*, *carrasco* or deciduous forest). Results are presented in histograms.

To test for differences in the composition of life-forms among physiognomies, we calculated the life-form spectrum, which is the proportion of species of each life-form. We determined which life-form characterized each physiognomy by comparing our results with the normal spectrum proposed by Raunkiaer (1934). This spectrum represents the world flora and was used here as null hypothesis. At first, we tested for differences between the obtained and the normal spectrum using a χ^2 test (Vieira 2004). When differences were significant, we calculated the relative contribution of each life-form's deviation to the computed χ^2 statistic. The life-form with higher contribution in each test was considered as characteristic of the physiognomy where it occurs.

To test for similarities with other Brazilian vegetation types (in terms of life-forms), we compiled studies with spectra determined for Brazilian physiognomies (Tab. 1). We kept the names used by each author for the vegetation types of each study. To facilitate comparison, we used only the five main life-form classes of Raunkiaer (1934). Hence, epiphytes and woody lianas were included in the class phanerophytes, saprophytes in cryptophytes, and aerophytes in chamaephytes. We compared the life-form spectra found in Serra das Almas Natural Reserve with those from other studies with a detrended correspondence analysis – DCA (Jongman *et al.* 1995; Batalha & Martins 2002); results were expressed in ordination diagrams with scores of each study and of each life-form.

Results

We recorded 419 species/morphospecies from 72 families (Annex 1). Families (55) and species richness (250) were higher in the deciduous forest. Richness values of the *carrasco* (46 and 136) and *caatinga* (44 and 137) were similar to each other and lower than in the deciduous forest.

Fabaceae (86 species), Euphorbiaceae (38 species) and Convolvulaceae (22 species) were the richest plant families in Serra das Almas Natural Reserve. The richest families were different among physiognomies (Fig. 2). The exception was the family Fabaceae, which had the highest number of species in all three physiognomies (Fig. 2). However, the representativeness of subfamilies varied, with higher richness of Papilionoidae in the deciduous forest (25 species) and of Caesalpinioidae in the *caatinga* (12 species) and *carrasco* (15 species).

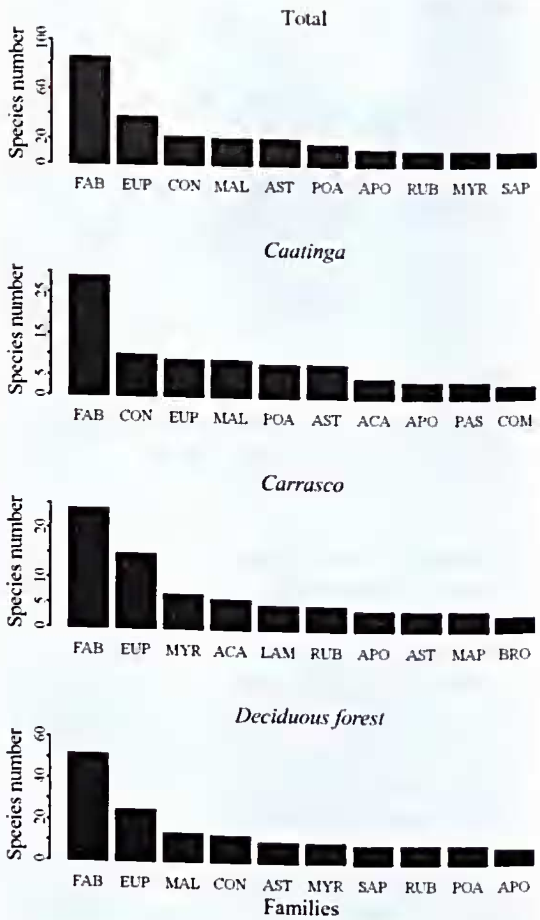

Figure 2 – Species-richest families in the three physiognomies of Serra das Almas Natural Reserve, Crateús, state of Ceará, Brazil. Abbreviations for families: FAB–Fabaceae, EUP–Euphorbiaceae, CON- Convolvulaceae, MAL– Malvaceae, AST– Asteraceae, POA–Poaceae, APO–Apocynaceae, RUB – Rubiaceae, MYR–Myrtaceae, SAP–Sapindaceae, ACA–Acanthaceae, PAS–Passifloraceae, COM–Commelinaceae, LAM–Lamiaceae, MAP–Malpighiaceae, BRO–Bromeliaceae.

Family overlap was about one third among all physiognomies (Fig. 3). However, the *carrasco* and the deciduous forest shared the highest number of families, and had the highest (*carrasco*) and lowest (deciduous forest) number of exclusive families (Fig. 3). Species overlap was low, as only nine out of 419 species occurred in all physiognomies (Fig. 3). The *carrasco* and the deciduous forest had higher floristic affinity with each other, since they shared more species (15%) and both had low overlap with the *caatinga* (1.3 % overlap with *carrasco* and 4.2% with deciduous forest – Fig. 3).

Table 1 – Life-form spectra used for comparisons in a detrended correspondence analysis (DCA). Life-forms: Th – therophytes, Cr – cryptophytes, H – hemicryptophytes, Ch – chamaephytes, Ph – phanerophytes.

Vegetation type	Abbreviation	Site	Reference	Th	Cr	H	Ch	Ph
caatinga	caa	Sa. das Almas, Crateús, CE	This study	47,9	1,4	6,3	18,1	26,4
carrasco	carr	Sa. das Almas, Crateús, CE	This study	17,2	3,4	3,4	17,9	57,9
deciduous forest	fl dec	Sa. das Almas, Crateús, CE	This study	14,6	2,6	2,2	22,5	58,1
caatinga	caa	Faz. Não me Deixes, Quixadá, CE	Costa *et al.* (2007)	42,9	2,3	12,8	15,8	26,3
cerrado fechado	cer fec	Brasília, DF	Ratter (1980) in Batalha & Martins (2002)	0,7	1,8	44,9	13,5	39,1
cerrado aberto	cer ab	PARNA das Emas, GO	Batalha & Martins (2002)	3,7	2	49,9	12,8	31,6
cerrado aberto	cer ab	Lagoa Santa, MG	Warming (1892) in Batalha & Martins (2002)	4,6	5,4	55,1	6,1	28,8
cerrado aberto	cer ab	Mojiguaçu, SP	Mantovani (1983) in Batalha & Martins (2002)	7,8	2,1	47	12,2	30,9
cerrado fechado	cer fec	Pirassununga, SP	Batalha *et al* (1997) in Batalha & Martins (2002)	5,6	1,1	36,1	17,1	40,1
cerrado fechado	cer fec	Sta. Rita do Passa Quatro, SP	Batalha &Mantovani (2001) in Batalha & Martins (2002)	6,7	0,8	30	17,2	45,3
pluvial forest	fl pl	Alto do Palmital, Foz do Iguaçu, PR	Cain *et al.* (1956)	0	3	11	6	80
pluvial forest	fl pl	Caiobá, PR	Cain *et al.* (1956)	0	3	3	7	87
pluvial forest	fl pl	Mucambo, Belém, PA	Cain *et al.* (1956)	0	0,9	2,8	0,9	95,4
temperate forest	fl temp	Horto Botânico, Pelotas, RS	Cain *et al.* (1956)	5	5	16	4	70
cerradão	cerradão	Águas de Sta. Barbara, SP	Meira Neto *et al.* (2007)	0	0	4	1,3	94,7
cerrado sensu strictu	cer ss	Águas de Sta. Barbara, SP	Meira Neto *et al.* (2007)	0	2,8	10,7	9,6	77
campo cerrado	cp cer	Águas de Sta. Barbara, SP	Meira Neto *et al.* (2007)	0	6,4	19,2	14,1	60,3
campo sujo	cp sj	Águas de Sta. Barbara, SP	Meira Neto *et al.* (2007)	0	7,9	31,8	41,3	19,1
campo limpo	cl lp	Águas de Sta. Barbara, SP	Meira Neto *et al.* (2007)	5	0	32	34	14
restinga	res	Itamaracá, PE	Almeida JR *et al.* (2007)	16,8	5,3	8	19,5	50,4
inselberg vegetation	inselb	Quixadá, CE	Araújo *et al.* (2008)	44,2	2,6	13	15,6	24,7
cerrado sensu strictu	cer ss	Itirapina, SP	Batalha & Martins (2004)	1,8	1,8	18,6	11,5	66,4
caatinga	caa	Betânia, PE	Costa *et al.* (2009)	40,5	1,1	14,6	18	25,8
restinga	res	Caravela, BA	Meira Neto *et al.* (2005)	9	0	14,9	23,9	52,2
restinga	res	Mucurí, BA	Meira Neto *et al.* (2005)	7,5	0	28,3	24,5	39,6

Note: *caatinga* = xeric shrubland; *carrasco* = deciduous shrubland; *cerrado sensu stricto* = savanna; *cerrado fechado* = dense savanna; *cerrado aberto* = open savanna; *campo cerrado* = grassland with scatered shrubs; *campo sujo* = grassland with scatered shrubs; *campo limpo* = grassland; *cerradão* = tall woodland savanna; *restinga* = sandy coastal plains.

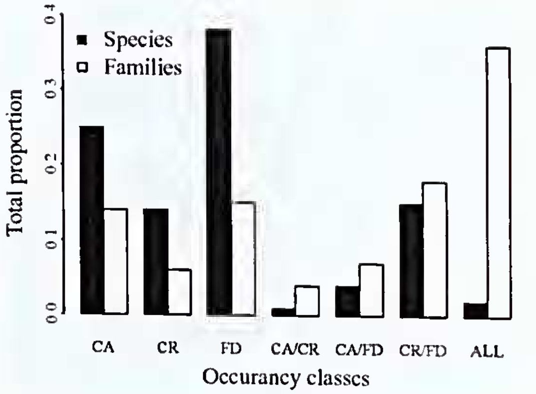

Figure 3 – Proportion of families (white) and species (black) occurring in one, two or in all physiognomies (CA – *caatinga*, CR – *carrasco*, DF – deciduous forest) of Serra das Almas Natural Reserve, Crateús, state of Ceará, Brazil.

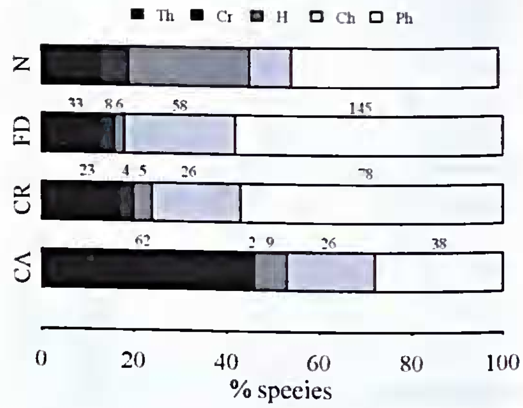

Figure 4 – Life-form spectra of the three physiognomies (CA – *caatinga*, CR – *carrasco*, DF – deciduous forest) of Serra das Almas Natural Reserve, Crateús, state of Ceará, Brazil, compared to Raunkiaer's normal spectrum (N). Values over each physiognomy bar indicate the number of species of each life-form. Species percentages of each life-form are expressed by the width of the bar. Life-forms: therophyte (Th), cryptophyte (Cr), hemicryptophyte (H), chamaephyte (Ch), phanerophyte (Ph).

In the physiognomies on sedimentary relief, woody species (shrubs and trees) predominated, totaling 124 in the deciduous forest and 68 in the *carrasco*. In the *caatinga*, on the crystalline basement, the highest species richness (69) was represented by herbs.

The life-form spectra of the studied physiognomies differed significantly from the normal spectrum (*caatinga*: $\chi^2 = 159.33$ $p < 0.01$ df = 4; *carrasco* $\chi^2 = 49.07$ $p < 0.01$ df = 4; deciduous forest $\chi^2 = 120$, $p < 0.01$ df = 4). In general, the *carrasco* and the deciduous forest exhibited similar proportions of species of each life-form, whereas the *caatinga* exhibited a different spectrum (Fig. 4). Therophytes, hemicryptophytes and chamaephytes were the predominant life-forms in the *caatinga* (69 %), *carrasco* (53%) and deciduous forest (46%), respectively; thus, they characterize each physiognomy.

In the comparisons of life-form spectra among physiognomies of Serra das Almas Natural Reserve with other Brazilian vegetation types, the two first axes of the DCA corresponded to over 60% of the total inertia: 49.68% on the first axis and 13.30 % on the second. In the ordination diagram three groups of life-form spectra stood out: i) spectra with scores next to the ones of phanerophytes, ii) of cryptophytes and iii) of chamaephytes and therophytes (Fig. 5). The life-form spectra of the *carrasco* and the deciduous forest in Serra das Almas Natural Reserve nearly overlapped in the ordination space, in group 2, which also comprises the *restinga* and *cerrado* spectra (Fig. 5). In this group, *carrasco* and deciduous forest exhibited scores close to those of *restinga* and different from those of cerrado, apparently because of the lower proportion of cryptophytes (Fig. 5). The *caatinga* composed a well-defined group, which comprised spectra of other *caatinga* studies, including vegetation on inselbergs. This group is associated with higher proportion of chamaephytes and therophytes (Fig. 5).

Discussion

In general, in the semi-arid region of northeastern Brazil, areas with higher annual average rainfall associated with higher altitudes exhibit higher species richness (Lima *et al.* 2009; Araújo *et al.* 2007; Ferraz *et al.* 1998; Gomes 1980). This pattern was also observed in the physiognomies of deciduous forest and carrasco, both located at higher altitudes than the caatinga in Serra das Almas Natural Reserve. Besides, deciduous vegetation on sedimentary areas, even with rainfall indexes similar to the *caatinga* area of the crystalline basement, have been pointed out in general as having higher species richness (Silva *et al.* 2003), though there are some exceptions (Rodal *et al.* 1998; Pereira *et al.* 2002). These exceptions show that being sedimentary alone does not result in higher species richness; other

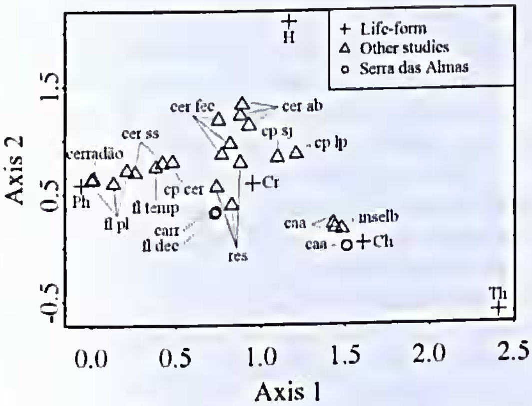

Figure 5 – Ordination diagram of the detrended correspondence analysis (DCA), with scores of life-forms and compiled inventories, including the physiognomies of Serra das Almas Natural Reserve. Abbreviations for vegetation types follow Table 1. Life-forms: therophyte (Th), cryptophyte (Cr), hemicryptophyte (H), chamaephyte (Ch), phanerophyte (Ph).

factors must also be considered, such as the position of the hogback, level of desiccation of the relief and physiochemical composition of the soil. The deciduous forest of Serra das Almas Natural Reserve is located on the windward side, between 500 m and 700 m, whereas the *carrasco*, though located at a higher altitude about 700 m, is located on the leeward side and on sandier soils, which results in a physiognomy of lower height, smaller and slender plants and lower richness than in the deciduous forest.

Concerning the herbaceous component of the Brazilian semi-arid flora, studies carried out in the inter-plateau depression of the crystalline complex indicate that the highest richness of the *caatinga sensu stricto* is in the herbaceous component (Sampaio 1995; Rodal *et al.* 2005; Costa *et al.* 2007; Mamede & Araújo 2008). Comparatively, studies carried out in sedimentary formations recorded low richness of herbaceous flora (Rodal *et al.* 1999; Figueirêdo *et al.* 2000).

In Serra das Almas Natural Reserve, the floristic richness of woody species increased at high altitudes in areas of deciduous forest and *carrasco*, whereas the richness of herbaceous species decreased. The increase in richness of trees and shrubs with altitude seems to be a general pattern for vegetation of arid and semi-arid regions. In the Brazilian semi-arid region, the increase in richness of herbaceous growth-forms and decrease in woody growth-forms is related to the increase in aridity (lower rainfall and higher temperature). In previous studies, the replacement of non-woody life-forms by woody life-forms and the increase in richness along humidity gradients have been observed in arid areas (Pavón *et al.* 2000), tropical savannas (Williams *et al.* 1996), forests and temperate grasslands (Kovács-Lang *et al.* 2000).

Considering woody and herbaceous flora together, the deciduous forest on the sedimentary basin exhibited higher richness than the *caatinga* located on the crystalline basement. Potentially, there must be higher humidity in the air and soil resulting from the elevation; there must be also soils with permanent water availability in deep layers (latosols and quartz sands), which possibly contribute to the higher floristic richness observed.

Comparing the *carrasco* and the deciduous forest located in the same sedimentary basin, the latter exhibited higher richness. In this case, humidity seems to be an important factor: the deciduous forest is located on the cuesta and the carrasco on the immediate backside. On the backside the air is probably drier and wind speed is higher, which causes more desiccation. Besides, soil seems to play a role too, since *carrasco* soils are sandier (Araújo & Martins 1999; Araújo *et al.* 1999).

Despite the high species richness found in the region of Ibiapaba Plateau, it is important to highlight the contribution of the non-woody component (herbs, subshrubs and herbaceous lianas) to the total species richness of each physiognomy. In the *caatinga*, on the crystalline basement, non-woody plants were responsible for most of the floristic richness, that is expected in arid and semi-arid climates, due to the predominance of therophytes in these environments. On the contrary, in the *carrasco* and in the deciduous forest, woody plants were responsible for the highest richness, since in more humid climates phanerophytes predominate.

Higher water availability favors the establishment of life-forms that do not need large reductions of the aerial shoot system during the unfavorable season (phanerophytes), which is a necessary strategy for the survival of most species in arid and semi-arid regions (see Raunkiaer 1934; van Rooyen *et al.* 1990; Kovács-Lang *et al.* 2000). In the case of Serra das Almas Natural Reserve, which is inserted in a semi-arid climatic domain, the increase in altitude may potentially favor high water availability on the windward side. Besides, soil must be taken into account, since there are two different geological units: lowlands of the crystalline basement and the Meio Norte sedimentary basin.

Herbaceous or sub-woody plants (herbs, subshrubs and herbaceous lianas) are the life-forms that exhibit the highest reduction of the aerial shoot system during the dry season (therophytes, cryptophytes, and hemicryptophytes; Raunkiaer 1934). The biological spectrum of the *caatinga* studied was characterized mainly by therophytes, a life-form characteristic of arid and semi-arid regions (Raunkiaer 1934; van Rooyen *et al.* 1990; Kovács-Lang *et al.* 2000). Indeed, among the three physiognomies studied, the *caatinga* occurs on shallow soils in the lowlands of the crystalline basement, where temperature is potentially higher and rainfall is potentially lower than in mountain-range areas, resulting in lower water availability. The physiognomies on the Ibiapaba plateau (*carrasco* and deciduous forest) must occur under lower water restrictions, since higher altitude contributes to the potential occurrence of higher rainfall and lower temperature, which favor phanerophytes, a life-form characteristic of sites with lower water restriction.

In addition to numeric differences in species richness, remarkable differences between the floristic complexes of each physiognomy were observed in the present study. The two main complexes (*caatinga* and *carrasco* + deciduous forest) are consistent with the soil types that occur in the area, resulting from the type of source rock. Although species overlap between deciduous forest and *carrasco* may be considered low (15%), differences are even larger when compared with caatinga, whose overlap is only 4%. *Carrasco* and deciduous forest are floristically more similar because both have a set of species that prefer sandy soil with low pH, whereas *caatinga* differs from that floristic group by the presence of species typical of soils originated from the crystalline basement of the inter-plateau depression. The crystalline and sedimentary floras of northeastern Brazil also differ at a broader scale, as it was observed in analyses of data matrices created from local inventories, carried out in several areas of the Brazilian semi-arid region (Araújo *et al.* 1998a, b; Lemos & Rodal 2002; Alcoforado-Filho *et al.* 2003; Araújo *et al.* 2005; Lima *et al.* 2009).

As Andrade-Lima (1981) emphasized, in the Brazilian semi-arid region, when the predominant variation is in climate, as observed in the two physiognomies studied in the Ibiapaba Plateau (the deciduous forest occurs on the windward side whereas the *carrasco* occurs on the leeward side), these do not form discrete units. They form a continuum represented by species overlap and by the same biological spectrum, as emphasized by Austin (2005).

When analyzing physiognomies on different geomorphological units, apart from the climate, the soil component may determine discrete units: communities that, according to Whittaker (1975), can be delimited by floristic composition and life-forms, such is the case of the difference found between the *caatinga* and the complex deciduous forest + *carrasco*.

In the comparative analysis with the biological spectra from other Brazilian seasonal vegetation types, the discrimination of the *caatinga* by higher proportion of therophytes and chamaephytes shows that this vegetation is composed of species whose life-forms represent better the semi-arid climatic pattern, since the predominance of these life-forms is characteristic of vegetations of arid and semi-arid environments (Raunkiaer 1934; Cain 1950). The biological spectrum is similar to the spectrum of arid and semi-arid climate zones of the world.

In summary, the two geomorphological units present in the study area have two distinct floristic complexes, characterized by the predominance of therophytes on the crystalline basement and of phanerophytes on the sedimentary basin. These results show that when implementing reserves in Brazilian semi-arid areas, abiotic local factors, such as soils and relief, must be taken into account, because these factors seem to reflect regional floristic variation. The environmental heterogeneity may result not only in high species diversity, but also in high functional diversity in the Brazilian semi-arid domain, which, in the present study, may be observed in differences in life-form spectra among the three physiognomies analyzed.

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Annex 1 – List of families and species found, with respective growth-forms and life-forms, in three phytophysiognomies, *caatinga* (CA), *carrasco* (CR) and deciduous forest (DF), of the Natural Reserve Serra das Almas, Ceará State, deposited in the EAC Herbarium of the Universidade Federal do Ceará. x = presence of species in the phytophysionogmy. Growth-form (FC) = tree (tre), shrub (shr), sub-shrub (sub), liana (lia), herb (her). Life-form (FV) = phanerophyte (Ph), chamaephyte (Ch), hemicryptophyte (H), therophyte (Th), cryptophyte (Cr).

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Acanthaceae							
Anisacanthus trilobus Lindau	pimentinha	sub	Ch	x	x		F.S. Araújo, 1593
Dicliptera ciliaris Juss.		sub	Ch	x		x	S.F. Vasconcelos, 9
Elytraria sp.		sub	H	x			S.F. Vasconcelos, 8
Justicia fragilis Wall. ex Clarke		sub	Ch		x	x	F.S. Araújo, 1490
Justicia strobilacea (Nees) Lindau		shr	Ph		x	x	F.S. Araújo, 1458
Justicia sp.		shr	Ph	x			F.S. Araújo, 1539
Lophothecium sp.		sub	Ch			x	M.S. Sobrinho, 124
Ruellia cf. *bahiensis* (Nees) Morong		sub	Ch		x		F.S. Araújo, 1576
Ruellia paniculata L.	melosa-de-bode, melosa	shr	Ch	x	x		F.S. Araújo, 1547
Ruellia villosa Lindau		sub	Ch		x	x	M.S. Sobrinho, 125
Achariaceae							
Lindackeria ovata (Benth.) Gilg	mamona-brava	tre	Ph			x	R.C. Costa 269
Alstroemeriaceae							
Alstroemeria sp.		her	Cr			x	F.S. Araújo, 1511
Bomarea edulis (Tussac) Herb.		her	Cr			x	F.S. Araújo, 1442
Amaranthaceae							
Alternanthera brasiliana (L.) Kuntze	quebra-panela, cabeça-branca	her	Th	x	x	x	F.S. Araújo, 1377
Alternanthera brasiliana var. *villosa* (Moq.) Kuntze		her	Th	x	x		F.S. Araújo, 1505
Froelichia lanata Moench		her	Th	x		x	F.S. Araújo, 1400
Gomphrena demissa Mart.		her	Th			x	F.S. Araújo, 1436
Amaryllidaceae							
Hippeastrum sp.	cebola-brava	her	Cr			x	F.S. Araújo, 1330
Anacardiaceae							
Myracrodruon urundeuva Allemão	aroeira	tre	Ph	x			Probio, 400

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Annonaceae							
Duguetia riedeliana R. E. Fr.	camueá	tre	Ph			x	Probio, 214
Ephedranthus pisocarpus R. E. Fr.	condurú	tre	Ph		x	x	J.R. Lima, 16
Rollinia leptopetala R. E. Fr.	bananinha	shr	Ph		x	x	M.S. Sobrinho, 15
Apocynaceae							
Allamanda blanchetii A. DC.	pente-de-macaco, cravo-de-cachorro	lia	H	x	x	x	F.S. Araújo, 1335
Aspidosperma cuspa (Kunth) S.F. Blake ex Pittier	pereiro-branco	tre	Ph	x			F.S. Araújo, 1352
Aspidosperma discolor A. DC.	canela-de-velho, caneleiro	tre	Ph			x	J.R. Lima, 18
Aspidosperma multiflorum A. DC.	piquiá	tre	Ph			x	J.R. Lima, 19
Aspidosperma pyrifolium Mart.	pereiro-preto, pereiro	tre	Ph	x			Probio, 403
Aspidosperma cf. *subincanum* Mart. ex A. DC.	piquiá	tre	Ph			x	M.S. Sobrinho, 245
Mandevilla scabra (Hoffmanns. ex Roem. & Schult.) K.Schum.		lia	Ch		x		F.S. Araújo, 1497
Mandevilla tenuifolia (J. C. Mikan) Woodson		her	Cr		x		F.S. Araújo, 1323
Matelea harleyi Fontella & Morillo		lia	Ch	x			F.S. Araújo, 1543
Prestonia bahiensis Müll Arg.		lia	Ph			x	F.S. Araújo, 1290
Secondatia floribunda A. DC.		lia	Ph			x	J.R. Lima, 89
Tabernaemontana catharinensis A. DC.	grão-de-porco	shr	Ph		x		F.S. Araújo, 1479
Tassadia burchelii E. Fourn.		lia	Ph			x	J.R. Lima, 13
Araceae							
Scaphispatha gracilis Brongn. ex Schott		her	Cr			x	L.W. Lima-Verde, 1091
Spathicarpa hastifolia Hook.		her	Cr			x	F.S. Araújo, 1379
Taccarum peregrinum (Schott) Engl.	milho-de-cobra	her	Cr	x			R.C. Costa, 358
Asteraceae							
Acmella uliginosa (Sw.) Cass.	agrião	her	Th	x			F.S. Araújo, 1407
Aspilia cf. *attenuata* (Gardner) Baker		her	Th		x		F.S. Araújo, 1503
Aspilia bonplandiana (Gardner) S. F. Blake		her	Th		x		F.S. Araújo, 1590
Blainvillea lanceolata Baker		her	Th	x		x	R.C. Costa, 97
Blainvillea latifolia (L. f.) DC.		her	Th	x			R.C. Costa, 441
Blainvillea ligulata (L. f.) DC.	bamburral	her	Th	x			R.C. Costa, 436
Blainvillea rhomboidea Cass.		her	Th			x	M.S. Sobrinho, 52

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Centratherum punctatum Cass.		her	Th	x			R.C. Costa, 456
Delilia biflora (L.) Kuntze		her	Th	x			R.C. Costa, 440
Dissothrix imbricata (Gardner) B. L. Rob.		her	Th		x		F.S. Araújo, 1467
Jaegeria hirta (Lag.) Less		her	Th	x			S.F. Vasconcelos, s/n
Lagascea mollis Cav.		her	Th	x			S.F. Vasconcelos, 12
Melampodium camphoratum (L. f.) Baker		her	Th			x	F.S. Araújo, 1422
Melanthera latifolia (Gardner) Cabrera		her	Th			x	Probio, s/n
Pithecoseris pacourinoides Mart. ex DC.		her	Th			x	M.S. Sobrinho, 109
Stilpnopappus sp.		her	Th			x	M.S. Sobrinho, 84
Trichogonia cf. *menthifolia* Gardner		her	Th			x	F.S. Araújo, 1560
Vernonia aff. *arenaria* Mart. ex DC.		sub	Ph		x		F.S. Araújo, 1497
Vernonia obscura Less.		shr	Ph			x	F.S. Araújo, 1450
Wedelia hookeriana Gardner		her	Th			x	F.S. Araújo, 1287
Wedelia villosa Gardner		sub	Ch			x	J.R. Lima, 85
Bignoniaceae							
Anemopaegma ataidei A.Gentry		lia	Ph			x	M.S. Sobrinho, 236
Arrabidaea caudigera (S. Moore) A.H.Gentry		lia	Ph	x			R.C. Costa, 320
Arrabidaea chica(Humb. & Bonpl.) Verl.		lia	Ph		x		J.R. Lima, 21
Arrabidaea corallina (Jacq.) Sandwith		lia	Ph			x	M.S. Sobrinho, 31
Arrabidaea dispar Bureau ex K. Schum.		lia	Ph			x	J.R. Lima, 20
Jacaranda jasminoides (Thunb.) Sandwith	jacarandá	tre	Ph			x	R.C. Costa, 95
Pithecoctenium crucigerum (L.) A.H. Gentry	pente-de-macaco	lia	Ph			x	M.S. Sobrinho, 231
Tabebuia impetiginosa (Mart. ex DC.) Standl.	pau-d'arco-roxo	tre	Ph	x			Observada
Tabebuia ochracea (Cham.) Standl.	pau-d'arco	tre	Ph			x	J.R. Lima, 23
Bixaceae							
Cochlospermum vitifolium (Willd.) Spreng.	pacotê	tre	Ph	x		x	S.F. Vasconcelos, 4
Boraginaceae							
Cordia leucomalloides Taroda	maria-preta	shr	Ph		x	x	L.W. Lima-Verde, 1181
Cordia oncocalyx Allemão	pau-branco	tre	Ph	x			R.C. Costa, 404
Cordia rufescens A. DC.	grão-de-galo	shr	Ph		x	x	F.S. Araújo, 1478
Tournefortia sp.		lia	Ph			x	F.S. Araújo, 1329

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Brassicaceae							
Brassica sp.		her	Th	x			F.S. Araújo, 1401
Bromeliaceae							
Bromelia auriculata L.B.Sm.	macambirinha	her	Ch			x	L.W. Lima-Verde, 1222
Bromelia laciniosa Mart. ex Schult. f.	macambira	her	Ch		x		L.W. Lima-Verde, 1216
Bromelia plumieri (E. Morren) L.B.Sm.	croatá	her	Ch	x	x	x	L.W. Lima-Verde, 983
Encholirium erectiflorum L. B. Sm.	macambira-de-flexa	her	Ch		x		L.W. Lima-Verde, 981
Burseraceae							
Commiphora leptophloeos (Mart.) J.B. Gillett	imburana-de-espinho	tre	Ph	x		x	J.R. Lima, 48
Cactaceae							
Cereus albicaulis (Britton & Rose) Luetzelb.	rabo-de-raposa	shr	Ph		x		Observada
Cereus jamacaru DC.	mandacaru	tre	Ph	x	x	x	Observada
Capparaceae							
Cynophalla flexuosa (L.) J. Presl	feijão-bravo	shr	Ph	x			Observada
Crateva tapia L.	trapiá	tre	Ph	x			Probio, 563
Celastraceae							
Maytenus sp.		tre	Ph			x	J.R. Lima 100
Chrysobalanaceae							
Licania sclerophylla (Hook. f.) Fritsch	oiticica	tre	Ph	x			Probio, 327
Cleomaceae							
Cleome microcarpa Ule		her	Th	x			Probio, 204
Combretaceae							
Buchenavia capitata (Vahl) Eichler	mirindiba	tre	Ph			x	M.S. Sobrinho, 292
Combretum glaucocarpum Mart.	cipaúba	tre	Ph			x	L.W. Lima-Verde, 1111
Combretum lanceolatum Pohl ex Eichler	catinga-branca	shr	Ph		x		Probio, 326
Combretum leprosum Mart.	mofumbo	shr	Ph	x		x	F.S. Araújo, 1516
Combretum mellifluum Eichler	catinga-branca	shr	Ph		x		F.S. Araújo, 1473
Commelinaceae							
Callisia filiformis (M. Martens & Galeotti) D. R. Hunt		her	Th	x			F.S. Araújo, 1404
Commelina nudiflora L.		her	Th	x			R.C. Costa, 367
Dichorisandra hexandra (Aubl.) Standl.		her	Th		x		F.S. Araújo, 1393
Dichorisandra sp.		her	Th	x			R.C. Costa, 395

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Convolvulaceae							
Evolvulus elaeagnifolius Dammer		lia	Ch		x	x	F.S. Araújo, 1486
Evolvulus ericaefolius Schrank.		her	Th	x			F.S. Araújo, 1351
Evolvulus filipes Mart.		her	Th	x		x	F.S. Araújo, 1515
Evolvulus cf. *latifolius* Ker Gawl.		her	H		x		F.S. Araújo, 1509
Evolvulus macroblepharis Mart.		sub	Ch			x	J.R. Lima, 83
Evolvulus ovatus Fernald		her	Th	x		x	F.S. Araújo, 1523
Evolvulus pterocaulon Moric.		sub	Ch			x	M.S. Sobrinho, 268
Evolvulus sp.		sub	Ch		x		F.S. Araújo, 1395
Ipomoea asarifolia (Desr.) Roem. & Schult.		sub	Ch			x	M.S. Sobrinho, 283
Ipomoea bahiensis Willd. ex Roem. & Schult.	jitirana-da-folha-pequena	lia	Ch			x	F.S. Araújo, 1424
Ipomoea brasiliana Meins.		lia	Ph			x	J.R. Lima, 25
Ipomoea hederifolia L.	pimenteira	lia	Ch	x			R.C. Costa, 444
Ipomoea nil (L.) Roth	jitirana	lia	Th	x		x	R.C. Costa, 448
Ipomoea polymorpha Roem. & Schult.		her	Th	x			F.S. Araújo, 1522
Ipomoea rosea Choisy		lia	Ch			x	R.C. Costa, 92
Ipomoea sericophylla Meisn.		sub	Ch	x			Vasconcelos, S. F., 7
Ipomoea subincana Meisn.		lia	Ch			x	F.S. Araújo, 1372
Jacquemontia gracillima (Choisy) Hallier f.		her	Th	x			F.S. Araújo, 1521
Jacquemontia nodiflora (Desr.) G. Don		lia	Ch			x	F.S. Araújo, 1370
Jacquemontia pentantha (Jacq.) G. Don		lia	Ch			x	F.S. Araújo, 1420
Merremia aegyptia (L.) Urb.	jitirana	lia	Th	x			Costa, R. C., 453
Operculina alata Urb.	batata-de-purga	lia	Ph	x			S.F. Vasconcelos, 5
Cucurbitaceae							
Cayaponia racemosa (Mill.) Cogn.		lia	Ch			x	M.S. Sobrinho, 183
Cyperaceae							
Cyperus aggregatus (Willd.) Endl.		her	H			x	J.R. Lima, 106
Cyperus laxus Lam.		her	H			x	F.S. Araújo, 1363
Cyperus surinamensis Rottb.		her	Th	x			L.W. Lima-Verde, 1092
Cyperus uncinulatus Schrad. ex Nees	barba de bode	her	Th	x			R.C. Costa, 361
Kyllinga sp.		her	H			x	L.W. Lima-Verde, 1078
Rhynchospora sp.		her	Th	x			Probio, 199

Families/species	Common name	FC	FV	Phytophysiognomy			Collector
				CA	CR	DF	
Dilleniaceae							
Davilla cearensis Huber		lia	Ch			x	M.S. Sobrinho, 267
Dioscoreaceae							
Dioscorea ovata Vell.		lia	Cr		x		F.S. Araújo, 1482
Dioscorea sp.1		lia	Cr	x			R.C. Costa, 366
Dioscorea sp.2		lia	Cr			x	R.C. Costa, 55
Eriocaulaceae							
Syngonanthus sp.		her	Th		x		F.S. Araújo, 1498
Erythroxylaceae							
Erythroxylum amplifolium Baill.		shr	Ph			x	R.C. Costa, 89
Erythroxylum barbatum O. E. Schulz		shr	Ph		x	x	F.S. Araújo, 1306
Erythroxylum bezerrae Plowman		shr	Ph		x	x	F.S. Araújo, 1322
Erythroxylum laetevirens O. E. Schulz	pirunga	shr	Ph		x	x	F.S. Araújo, 1472
Erythroxylum nummularia Peyr.		shr	Ph			x	L.W. Lima-Verde, 952
Erythroxylum stipulosum Plowaman		shr	Ph			x	L.W. Lima-Verde, 1114
Erythroxylum vacciniifolium Mart.		shr	Ph			x	L.W. Lima-Verde, 952
Euphorbiaceae							
Acalypha multicaulis Müll. Arg.		sub	Ch			x	F.S. Araújo, 1365
Actinostemon sp.		shr	Ph			x	L.W. Lima-Verde, 1199
Bernardia sidoides (Klotzsch) Müll. Arg.		her	Th	x			F.S. Araújo, 1339
Chamaesyce hyssopifolia (L.) Small		her	H	x			F.S. Araújo, 1342
Cnidoscolus vitifolius (Mill.) Pohl	cansanção	shr	Ph		x	x	F.S. Araújo, 1309
Croton adenocalyx Baill.	catinga branca	shr	Ph	x			F.S. Araújo, 1346*Croton*
Croton argyrophylloides Müll Arg.	marmeleiro branco	shr	Ph		x	x	F.S. Araújo, 1294
Croton betacens Baill.		shr	Ph			x	F.S. Araújo, 1331
Croton blanchetianus Baill.	marmeleiro-preto, marmeleiro	shr	Ph	x		x	F.S. Araújo, 1356
Croton cordiifolius Baill.		shr	Ph		x	x	F.S. Araújo, 1280
Croton echioides Müll. Arg.		shr	Ph			x	F.S. Araújo, 1454
Croton glandulosus L.		her	Th	x			Probio, 208
Croton grewioides Baill.	canelinha	shr	Ph		x	x	J.R. Lima, 79
Croton heliotropiifolius Kunth	velame	shr	Ph		x		F.S. Araújo, 1310

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Croton jacobinensis Baill.		shr	Ph			x	L.W. Lima-Verde, 1044
Croton lundianus (Didr.) Müll. Arg.		her	Th	x			R.C. Costa, 350
Croton moritibensis Baill.		shr	Ph			x	L.W. Lima-Verde, 077
Croton nepetifolius Baill.	marmeleiro-cravinho	shr	Ph			x	F.S. Araújo, 1325
Croton odontadenius Müll. Arg.		shr	Ph			x	Probio 393
Croton rudolphianus Müll. Arg.		shr	Ph		x	x	F.S. Araújo, 1325
Croton urticifolius Lam.		her	Th		x		F.S. Araújo, 1376
Croton zehntneri Pax & K. Hoffm.	canelinha	shr	Ph		x	x	Probio, 40
Dalechampia pernambucensis Baill.		lia	Ch			x	F.S. Araújo, 1428
Euphorbia comosa Vell.		sub	Ch		x	x	F.S. Araújo, 1461
Euphorbia insulana Vell.		her	Th	x			S.F. Vasconcelos, s/n
Gymnanthes sp1.		shr	Ph			x	J.R. Lima, 29
Gymnanthes sp2.		tre	Ph			x	J.R. Lima, 27
Gymnanthes sp3.		shr	Ph		x	x	M.S. Sobrinho, 8
Jatropha mollissima (Pohl) Baill.	pinhão	tre	Ph	x			R.C. Costa, 350
Manihot anomala Pohl	maniçoba	shr	Ph		x		F.S. Araújo, 1318
Manihot glaziovii Müll. Arg.		shr	Ph			x	L.W. Lima-Verde, 1203
Manihot palmata Müll. Arg.	maniçoba	shr	Ph			x	F.S. Araújo, 1305
Maprounea sp.		tre	Ph		x	x	Probio, 273
Microstachys corniculata (Vahl) Griseb.		her	Th		x		F.S. Araújo, 1470
Poinsettia heterophylla (L.) Klotzsch & Garcke		her	Th	x			F.S. Araújo, 1531
Sapium lanceolatum (Müll. Arg.) Huber	burra-leiteira	tre	Ph		x	x	Probio, 14
Stillingia trapezoidea Ule		shr	Ph		x		F.S. Araújo, 1321
Tragia cf. *lessertiana* (Baill.) Müll. Arg.		lia	Ch			x	M.S. Sobrinho, 54
Fabaceae							
Caesalpinioideae							
Bauhinia acuruana Moric.		shr	Ph		x		Probio, 408
Bauhinia cf. *dubia* G. Don.		tre	Ph			x	J.R. Lima, 44
Bauhinia cheilantha (Bong.) Steud.	mororó	shr	Ph	x			F.S. Araújo, 1397
Bauhinia pentandra (Bong.) Vogel ex Steud.		tre	Ph	x			F.S. Araújo, 1411
Bauhinia pulchella Benth.	mororó	tre	Ph			x	F.S. Araújo, 1563
Bauhinia ungulata L.	mororó	tre	Ph			x	F.S. Araújo, 1569

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Chamaecrista barbata (Nees & C. Mart.) H.S. Irwin & Barneby		sub	Ch			x	F.S. Araújo, 1573
Chamaecrista belemii (H. S. Irwin & Barneby)		sub	Ch		x		F.S. Araújo, 1388
Chamaecrista calycioides (Collad.) Greene		her	H	x			Probio, 176
Chamaecrista diphylla (L.) Greene		her	H		x		F.S. Araújo, 1492
Chamaecrista duckeana (P.Bezerra & Afr.Fern.) H.S. Irwin & Barneby	canafístula-brava	sub	Ch	x		x	R.C. Costa, 442
Chamaecrista nictitans (L.) Moench		sub	Ch	x	x	x	F.S. Araújo, 1368
Chamaecrista ramosa (Vogel) H. S. Irwin & Barneby		sub	Ch			x	S.F. Vasconcelos, s/n
Chamaecrista repens (Vogel) H.S.Irwin & Barneby		sub	Ch		x		F.S. Araújo, 1484
Chamaecrista rotundifolia (Pers.) Greene		her	Hh	x			F.S. Araújo, 1410
Chamaecrista supplex (Benth.) Britton & Rose ex Britton & Killip		her	Hh	x			F.S. Araújo, 1526
Chamaecrista tenuisepala (Benth.) H.S.Irwin & Barneby		sub	Ch		x		F.S. Araújo, 1390
Chamaecrista zygophylloides (Taub.) H.S. Irwin & Barneby		sub	Ch			x	M.S. Sobrinho, 112
Copaifera martii Hayne	pau d'óleo	tre	Ph		x	x	M.S. Sobrinho, 57
Hymenaea eriogyne Benth.	jatobá-batinga	shr	Ph		x	x	F.S. Araújo, 1383
Hymenaea velutina Ducke	jatobá-de-porco, jatobá-de-veia	tre	Ph		x	x	F.S. Araújo, 1387
Libidibia ferrea (Mart. ex Tul.) L.P.Queiroz	jucá, pau-ferro	tre	Ph	x			F.S. Araújo, 1555
Peltogyne confertiflora (Mart. ex Hayne) Benth.		tre	Ph			x	J.R. Lima, 50
Poincianella bracteosa (Tul.) L.P.Queiroz	catingueira	tre	Ph	x			R.C. Costa, 401
Poincianella gardneriana (Benth.) L.P.Queiroz		tre	Ph	x			F.S. Araújo, 1538
Senna cearensis Afr. Fern.	besouro	shr	Ph		x	x	J. R. Lima, 46
Senna gardneri (Benth.) H. S. Irwin & Barneby	besouro	shr	Ph		x		R.C. Costa, 291
Senna lechriosperma H. S. Irwin & Barneby	besouro	shr	Ph		x	x	F.S. Araújo, 1382
Senna macranthera (DC.ex Collad.) H. S. Irwin & Barneby	besouro	shr	Ph		x		F.S. Araújo, s/n
Senna obtusifolia (L.) H. S. Irwin & Barneby	besouro	sub	Ch	x			Probio, 365
Senna rugosa (G. Don) H. S. Irwin & Barneby		shr	Ph		x	x	R.C. Costa, 308
Senna splendida (Vogel) H.S.Irwin & Barneby	besouro	shr	Ph			x	F.S. Araújo, 1566
Senna trachypus (Mart. ex Benth.) H. S. Irwin & Barneby	besouro	shr	Ph	x	x	x	R.C. Costa, 165
Mimosoideae							
Anadenanthera colubrina var. *cebil* (Griseb.) Altschul	angico	tre	Ph	x			R. C. Costa, 562
Chloroleucon acacioides (Ducke) Barneby & J. W. Grimes	arapiraca	tre	Ph			x	R.C. Costa, 319
Inga ingoides (Rich.) Willd.		tre	Ph			x	L.W. Lima-Verde, 1083

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Mimosa acutistipula (Mart.) Benth.		tre	Ph		x	x	F.S. Araújo, 1476
Mimosa caesalpiniifolia Benth.	sabiá	tre	Ph	x			R.C. Costa, 399
Mimosa invisa Mart. ex Colla	malícia	shr	Ph			x	M.S. Sobrinho, 27
Mimosa quadrivalvis var. *leptocarpa* (DC.) Barneby		lia	Ch			x	M.S. Sobrinho, 240
Mimosa sensitiva L.		lia	Ch			x	F.S. Araújo, 1441
Mimosa tenuiflora (Willd.) Poir.	jurema-preta	shr	Ph	x			F.S. Araújo, 1544
Mimosa ursina Mart.		sub	Ch	x			F.S. Araújo, 1369
Mimosa verrucosa Benth.		tre	Ph		x	x	F.S. Araújo, 1567
Parkia platycephala Benth.	faveira	tre	Ph		x		R.C. Costa, 286
Piptadenia stipulacea (Benth.) Ducke	jurema-branca	tre	Ph	x			F.S. Araújo, 1426
Pityrocarpa moniliformis (Benth.) Luckow & Jobson	catanduva	tre	Ph		x	x	F.S. Araújo, 1298
Senegalia langsdorffii (Benth.) Seigler & Ebinger	jurema-de-bode	shr	Ph		x	x	M.S. Sobrinho, 195
Senegalia polyphylla (DC.) Britton & Rose		tre	Ph			x	F.S.Araújo,1328
Senegalia tenuifolia (L.) Britton & Rose		tre	Ph	x			Probio, 335
Papilionoideae							
Aeschynomene histrix Poir.		her	Th	x			S.F. Vasconcelos, 17
Aeschynomene marginata Benth.		sub	Ch		x		F.S. Araújo, 1502
Amburana cearensis (Allemão) A.C. Sm.	cumarú, imburana-de-cheiro	tre	Ph	x		x	M.S. Sobrinho, 202
Andira surinamensis (Bondt) Splitg. ex Pulle		tre	Ph			x	M.S. Sobrinho, 285
Arachis dardanii Krapov. & W.C. Gregory	mondubim	her	Th	x			R.C. Costa, 369
Bowdichia virgilioides Kunth	sucupira	tre	Ph			x	Probio, 304
Centrosema brasilianum (L.) Benth.	feijão-de-rolinha	lia	H	x		x	R.C. Costa, 451
Centrosema pascuorum Mart. ex Benth.		her	Th	x			F.S. Araújo, 1518
Cranocarpus gracilis Afr. Fern. & P.Bezerra		sub	Ch			x	F.S. Araújo, 1371
Cratylia mollis Mart. ex Benth.		lia	Ph		x		F.S. Araújo, 1589
Crotalaria vitellina Ker Gawl.		her	Th			x	M.S. Sobrinho, 266
Dalbergia cearensis Ducke		tre	Ph			x	L.W. Lima-Verde, 1197
Desmodium distortum (Aubl.) J.F. Macbr.		sub	Ch			x	M.S. Sobrinho, 271
Desmodium sp. 1		sub	Ch	x			Probio, 157
Desmodium sp. 2		her	Th	x			Probio, 172
Desmodium sp. 3		sub	Ch			x	Probio, 277

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Dioclea grandiflora Mart. ex. Benth.	mucunã	lia	Ph	x			F.S. Araújo, 1535
Dioclea megacarpa Rolfe	mucunã	lia	Ph			x	Rabelo, J. L., 37
Erythrina velutina Willd.	mulungu	tre	Ph	x			R.C. Costa, 328
Galactia jussiaeana Kunth		lia	Ph		x	x	F.S. Araújo, 1586
Harpalyce brasiliana Benth.		shr	Ph			x	Probio, 303
Indigofera suffruticosa Mill.		sub	Ch			x	M.S. Sobrinho, 228
Lonchocarpus araripensis Benth.		tre	Ph			x	J.R. Lima, 49
Luetzelburgia auriculata (Allemão) Ducke	pau-mocó	tre	Ph			x	M.S. Sobrinho, 286
Machaerium acutifolium Vogel	violete	tre	Ph			x	F.S. Araújo, 1564
Machaerium stipitatum (DC.) Vogel	violete	tre	Ph			x	L.W. Lima-Verde, 1055
Ormosia fastigiata Tul.		tre	Ph			x	R.C. Costa, 417
Periandra coccinea (Schrader) Benth.		lia	Ch			x	F.S. Araújo, 1419
Plathymenia reticulata Benth.	candeia	tre	Ph			x	Probio, 300, 213
Platypodium elegans Vogel		shr	Ph			x	M.S. Sobrinho, 13
Rhynchosia phaseoloides (Sw.) DC.		sub	Ch			x	M.S. Sobrinho, 181
Sesbania marginata Benth.		sub	Ch	x			Probio, 418
Stylosanthes capitata Vogel		sub	Ch			x	M.S. Sobrinho, 51
Stylosanthes humilis Kunth		her	Th	x			S.F. Vasconcelos,16
Swartzia flaemingii Raddi	jacarandá, banha-de-galinha	tre	Ph		x	x	M.S. Sobrinho, 219
Vatairea macrocarpa (Benth.) Ducke		tre	Ph			x	M.S. Sobrinho, 293
Iridaceae							
Herbertia sp.		her	Cr			x	F.S. Araújo, 1375
Nemastylis sp.		her	Cr		x		F.S. Araújo, 1481
Lamiaceae							
Amasonia campestris (Aubl.) Moldenke		sub	Ch		x	x	F.S. Araújo, 1289
Hypenia salzmannii (Benth.) Harley		her	Th		x		F.S. Araújo, 1501
Hyptis platanifolia Mart. ex Benth.		her	Th			x	M.S. Sobrinho, 118
Hyptis simulans Epling		her	Th			x	F.S. Araújo, 1570
Hyptis suaveolens (L.) Poit.	alfazema-brava, alfazema	her	Th		x	x	F.S. Araújo, 1421
Marsypianthes chamaedrys (Vahl) Kuntze		her	Th	x	x		F.S. Araújo, 1406
Vitex schaueriana Moldenke	mama-cachorro	tre	Ph		x	x	R.C. Costa, 340

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Loasaceae							
Mentzelia fragilis Huber.	prega-prega	her	Th	x			R.C. Costa, 433
Loganiaceae							
Spigelia anthelmia L.		her	Th	x			F.S. Araújo, 1338
Lythraceae							
Cuphea campestris Koehne		her	Th		x		F.S. Araújo, 1408
Cuphea circaeoides Sm. ex Sims		her	Th			x	F.S. Araújo, 1343
Cuphea silvestris Vahl		her	H		x		F.S. Araújo, 1324
Malpighiaceae							
Banisteriopsis angustifolia (A. Juss.) B. Gates		lia	Ph			x	Probio, 01
Banisteriopsis lutea (Griseb.) Cuatrec.		lia	Ph			x	M.S. Sobrinho, 289
Banisteriopsis oxyclada (A. Juss.) B. Gates.		lia	Ph		x		F.S. Araújo, 1578
Banisteriopsis stellaris (Griseb) B. Gates		lia	Ph		x	x	M.S. Sobrinho, 94
Byrsonima gardneriana A. Juss.	murici	tre	Ph		x	x	M.S. Sobrinho, 251
Heteropterys trichanthera A. Juss.		shr	Ph	x			F.S. Araújo, 1536
Janusia janusioides W.R. Anderson.		lia	Ph		x		R.C. Costa, 80
Mascagnia rigida (A. Juss.) Griseb.	tingui	lia	Ch	x			F.S. Araújo, 1550
Peixotoa jussieuana Mart. ex A. Juss.		lia	Ph			x	F.S. Araújo, 1373
Malvaceae							
Corchorus hirtus L.		her	Th	x			F.S. Araújo, 1444
Guazuma ulmifolia Lam.	mutamba	tre	Ph	x			Probio, 331
Helicteres heptandra L.B. Sm.	saca-rolha	shr	Ph			x	M.S. Sobrinho, 43
Helicteres muscosa Mart.	saca-rolha	shr	Ph		x	x	F.S. Araújo, 1320
Luehea uniflora A. St.-Hil.		tre	Ph			x	M.S. Sobrinho, 252
Melochia cf. *longidentata* Goldberg		sub	Ch			x	M.S. Sobrinho, 273
Pavonia cancellata (L.) Cav.		sub	Ch	x		x	Probio, 270
Pavonia sp.1		sub	Ch			x	F.S. Araújo, 1559
Pavonia sp.2		sub	Ch			x	F.S. Araújo, 1561
Pavonia sp.3		sub	Ch			x	J.R. Lima, 90
Pseudobombax marginatum (A.St-Hil. Juss. & Cambess.) A. Robyns	embiratanha	tre	Ph	x			F.S. Araújo, 1553
Pseudoabutilon spicatum R. E. Fr.		her	Th	x		x	F.S. Araújo, 1437
Sida ciliaris L.		sub	Ch	x		x	F.S. Araújo, 1514

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Sida galheirensis Ulbr.		sub	Ch			x	F.S. Araújo, 1434
Sida glomerata Cav.		sub	Ch			x	M.S. Sobrinho, 56
Sida jussieuana DC.	malva	her	Th	x			R.C. Costa, 454
Waltheria brachypetela Turcz.		sub	Ch		x		F.S. Araújo, 1582
Waltheria ferruginea A. St.-Hil.		shr	Ph			x	M.S. Sobrinho, 254
Waltheria indica L.		sub	Ch			x	M.S. Sobrinho, 261
Waltheria macropoda Turcz.		sub	Ch	x			F.S. Araújo, 1524
Wissadula contracta (Link) R.E.Fr.	paco-paco	her	Th	x	x		Probio, 159
Marantaceae							
Calathea villosa Lindl.		her	Cr		x	x	F.S. Araújo, 1459
Meliaceae							
Trichilia elegans A. Juss.		shr	Ph		x	x	J. R. Lima, 31
Menispermaceae							
Cissampelos sp.		lia	Ch		x	x	Probio, 15
Moraceae							
Brosimum gaudichaudii Trécul	inharé	tre	Ph			x	Probio, 306
Myrtaceae							
Campomanesia aromatica (Aubl.) Griseb.	guabiraba	shr	Ph		x	x	J. R. Lima, 61
Eugenia aff. *dysenterica* DC.	jacaré	tre	Ph		x	x	F.S. Araújo, 1291
Eugenia flavescens DC.		tre	Ph		x	x	R.C. Costa, 14
Eugenia ligustrina (Sw.) Willd.	goiabinha	shr	Ph		x		L.W. Lima-Verde, 988
Eugenia piauhiensis O. Berg.	canela-de-veado	tre	Ph		x	x	F.S. Araújo, 1392
Eugenia punicifolia (Kunth) DC.	goiabinha	tre	Ph		x	x	F.S. Araújo, 1391
Eugenia aff. *uvalha* Cambess.		shr	Ph			x	J. R. Lima, 73
Myrcia acutiloba O. Berg.		shr	Ph		x		F.S. Araújo, 1594
Myrcia guianensis (Aubl.) DC.		shr	Ph			x	L.W. Lima-Verde, 1102
Myrcia multiflora (Lam.) DC.		shr	Ph			x	R.C. Costa, 318
Myrcia cf. *obtecta* (O. Berg) Kiaersk.		shr	Ph			x	M.S. Sobrinho, 264
Myrcia sp.		shr	Ph			x	R.C. Costa, 241
Nyctaginaceae							
Boerhavia coccinea Mill.	pega-pinto	her	H	x			L.W. Lima-Verde, 1108
Guapira graciliflora (Schmidt) Lundell	joão-mole	shr	Ph	x	x	x	J.R. Lima, 34

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Ochnaceae							
Ouratea aff. *disticha* Tiegh		tre	Ph			x	J.R. Lima, 54
Ouratea cf. *parvifolia* Engl.		tre	Ph			x	J.R. Lima, 53
Olacaceae							
Heisteria sp.		shr	Ph		x	x	Probio 285
Schoepfia sp.		tre	Ph		x	x	Probio 312
Ximenia americana L.	ameixa	shr	Ph			x	J.R. Lima, 55
Onagraceae							
Ludwigia erecta (L.) H. Hara		her	Th	x			F.S. Araújo, 1540
Opiliaceae							
Agonandra brasiliensis Miers ex Benth. & Hook. f.	pau-marfim	tre	Ph		x	x	M.S. Sobrinho, 294
Oxalidaceae							
Oxalis divaricata Mart. ex Zucc.		sub	Ch	x	x	x	M.S. Sobrinho, 88
Oxalis frutescens L.		sub	Ch		x	x	F.S. Araújo, 1460
Passifloraceae							
Passiflora cincinnata Mast.	maracujá	lia	Ph		x		F.S. Araújo, 1480
Passiflora foetida L.	cheira-raposa, maracujá-de-raposa, maracujá-de-estalo	lia	Ch	x			L.W. Lima-Verde, 1210
Piriqueta guianensis N. E. Br.		sub	Ch	x			F.S. Araújo, 1349
Piriqueta sidifolia (A. St.-Hil. & A. Juss. & Cambess.) Urb.		sub	Ch			x	R.C. Costa, 66
Turnera blanchetiana Urb.		shr	Ph			x	F.S. Araújo, 1283
Turnera coerulea Sessé & Moc. ex DC.	chanana	sub	Ch		x	x	F.S. Araújo, 1389
Turnera pumilea L.		sub	Ch	x			F.S. Araújo, 1336
Turnera subulata Sm.	chanana	sub	Ch	x			F.S. Araújo, 1340
Plantaginaceae							
Angelonia cornigera Hook.		her	Th		x		F.S. Araújo, 1491
Dizygostemon floribundum (Benth.) Radlk ex. Wettst.		her	Th		x		F.S. Araújo, 1493
Scoparia dulcis L.	vassourinha	sub	Ch	x			L.W. Lima-Verde, 1193
Phyllanthaceae							
Phyllanthus caroliniensis Walter		her	Th	x			Probio, 202
Phyllanthus niruri L.		her	Th		x		F.S. Araújo, 1507
Phyllanthus orbiculatus Rich.		her	Th	x			R.C. Costa, 368
Phyllanthus sp.		her	Th	x			R.C. Costa, 357

Families/species	Common name	FC	FV	Phytophysiognomy			Collector
				CA	CR	DF	
Plumbaginaceae							
Plumbago scandens L.		sub	Ch			x	M.S. Sobrinho, 107
Poaceae							
Cenchrus ciliaris L.		her	Th			x	M.S. Sobrinho, 66
Chaetium festucoides Nees		her	Th			x	M.S. Sobrinho, 93
Eragrostis cf. *ciliaris* (L.) R. Br.		her	Th	x			S.F. Vasconcelos, 1
Lasiacis anomala Hitchc.		her	Th			x	M.S. Sobrinho, 96
Panicum cf. *maximum* Jacq.		her	Th	x			F.S. Araújo, 1403
Panicum sellowii Ness		her	Th			x	F.S. Araújo, 1364
Panicum trichoides Sw.	capim	her	Th	x	x	x	R.C. Costa, 433
Paspalum faveolatum Steud.		her	Th	x			S.F. Vasconcelos, s/n
Paspalum plicatulum Michx.	capim	her	Th	x			S. F. Vasconcelos, 1402
Pseudechinolaena sp.		her	Th			x	F.S. Araújo, 1440
Setaria geniculata P. Beauv.		her	Th	x			S.F. Vasconcelos, s/n
Setaria pauciflora Linden ex Herrm.		her	Th			x	M.S. Sobrinho, 92
Setaria rariflora J.C. Mikan ex Trin.		her	Th			x	M.S. Sobrinho, 38
Setaria cf. *tenax* (Rich.) Desv.		her	Th	x			R.C. Costa, 396
Steirachne diandra Ekman		her	Th		x		F.S. Araújo, 1499
Streptostachys asperifolia Desv.		her	Th		x	x	F.S. Araújo, 1307
Urochloa fasciculata (Sw.) R.D. Webster		her	Th	x			L.W. Lima-Verde, 1200
Polygalaceae							
Bredemeyera floribunda Willd.		lia	Ph		x	x	F.S. Araújo, 1572
Polygala gracilis Kunth		her	Th			x	F.S. Araújo, 1385
Polygala paniculata L.		her	Th		x	x	F.S. Araújo, 1384
Polygala violacea Aubl.		her	Th	x			F.S. Araújo, 1412
Pontederiaceae							
Heteranthera limosa (Sw.) Willd.		her	Ch	x			F.S. Araújo, 1541
Portulacaceae							
Portulaca pilosa L.	beldroega	her	Th	x			L.W. Lima-Verde, 1205
Talinum paniculatum (Jacq.) Gaertn.		her	Th	x		x	R. C. Costa, 354
Talinum triangulare (Jacq.) Willd.		her	Th	x	x		R. C. Costa, 368
Rhamnaceae							

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Colubrina cordifolia Reissek		shr	Ph		x	x	M.S. Sobrinho, 248
Gouania colurnifolia Reissek		lia	Ph		x		F.S. Araújo, 1577
Ziziphus joazeiro Mart.	juazeiro	tre	Ph	x			F.S. Araújo, 1354
Rubiaceae							
Alibertia myrciifolia Spruce ex K. Schum.		tre	Ph			x	J. R. Lima, 102
Chomelia martiana Müll. Arg.	espinho-judeu	shr	Ph			x	F.S. Araújo, 1452
Diodia cf. *barbeyana* Huber		her	Th		x	x	Probio, 231
Diodia radula (Willd. ex Roem. & Schult.) Cham. & Schltdl.		sub	Ch			x	M.S. Sobrinho, 242
Faramea sp.		tre	Ph			x	J.R. Lima, 104
Guettarda viburnoides Cham. & Schltdl.	genipapo-bravo	shr	Ph		x		F.S. Araújo, 1299
Margaritopsis carrascoana (Delprete & E.B. Souza) C.M. Taylor & E.B. Souza		sub	Ch		x	x	F.S. Araújo, s/n
Richardia grandiflora (Cham. & Schltdl.) Steud.		sub	Ch		x	x	F.S. Araújo, 1591
Spermacoce scabiosoides (Cham. & Schltdl.) Kuntze		her	H	x			F.S. Araújo, 1399
Spermacoce verticillata L.		her	H			x	M.S. Sobrinho, 75
Spermacoce sp.		her	Th	x			Probio, 201
Tocoyena formosa (Cham. & Schltdl.) K. Schum.	jenipapo-bravo	shr	Ph		x	x	F.S. Araújo, 1587
Rutaceae							
Galipea aff. *trifoliata* Aubl.		tre	Ph			x	J.R. Lima, 91
Pilocarpus spicatus Holmes	jaborandi	tre	Ph			x	F.S. Araújo, 1358
Zanthoxylum stelligerum Turcz.	limãozinho	shr	Ph		x		F.S. Araújo, 1592
Salicaceae							
Xylosma ciliatifolia (Clos) Eichler	espinho-de-judeu	tre	Ph		x	x	F.S. Araújo, 1301
Santalaceae							
Phoradendron sp.		hemip	Ch			x	M.S. Sobrinho, 257
Sapindaceae							
Allophylus cf. *sericeus* Radlk.	mama-cachorro	shr	Ph			x	F.S. Araújo, 1360
Cardiospermum corindum L.	pau-prá-tudo, laça-vaqueiro, chá-de-conhã	lia	Ch	x			F.S. Araújo, 1350
Magonia pubescens A.St.-Hil.	tingui-de-bola	tre	Ph		x	x	F.S. Araújo, 1380
Matayba guianensis Aubl.		tre	Ph			x	L.W. Lima-Verde, 1161

Families/species	Common name	FC	FV	Phytophysiognomy CA	CR	DF	Collector
Paullinia cearensis Somner & Ferrucci		lia	Ph			x	F.S. Araújo, 1304
Paullinia cf. *elegans* Cambess.		lia	Ph			x	J.R. Lima, 35
Sapindus saponaria L.	sabonete	tre	Ph			x	F.S. Araújo, 1510
Serjania glabrata Kunth		lia	Ph			x	M.S. Sobrinho, 290
Serjania lethalis A. St.-Hil.		lia	Ph		x		F.S. Araújo, 1597
Talisia esculenta (A. St.-Hil.) Radlk.	pitomba	tre	Ph			x	L.W. Lima-Verde, 1139
Urvillea laevis Radlk.		lia	Ph			x	M.S. Sobrinho, 234
Sapotaceae							
Chrysophyllum arenarium Allemão		shr	Ph			x	L.W. Lima-Verde, 1180
Chrysophyllum sp.		tre	Ph		x		F.S. Araújo, 1588
Manilkara sp.		tre	Ph			x	F.S. Araújo, 1557
Solanaceae							
Solanum baturitense Huber	jurubeba	shr	Ph		x		F.S. Araújo, 1579
Solanum crinitum Lam.	jurubeba	shr	Ph		x		F.S. Araújo, 1580
Trigoniaceae							
Trigonia nivea Cambess.		lia	Ph			x	L.W. Lima-Verde, 1253
Ulmaceae							
Trema micrantha (L.) Blume		tre	Ph		x		F.S. Araújo, 1575
Urticaceae							
Laportea aestuans (L.) Chew		her	Th	x			Probio, 348
Verbenaceae							
Lantana camara L.	camará, chumbinho	shr	Ph	x		x	R.C. Costa, 370
Lantana fucata Lindl.		sub	Ch		x		F.S. Araújo, 1312
Lippia gracilis Schauer		shr	Ph		x		R.C. Costa, 523
Lippia magentea T. Silva		sub	Ch			x	F.S. Araújo, 1292
Stachytarpheta cayennensis (Rich.) Vahl		her	Th	x			F.S. Araújo, 1398
Violaceae							
Hybanthus ipecacuaha (L.) Baill.	pepaconha	her	H		x		F.S. Araújo, 1386
Vitaceae							
Cissus gongylodes (Burk ex Baker) Planch.		lia	Ch	x			R.C. Costa, 374
Cissus tinctoria Mart.		lia	Ch			x	F.S. Araújo, 1427